Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 3 Certificate

Tuesday 11 June 2024

Afternoon (Time: 1 hour 40 minutes)

Paper reference **7MC0/02**

Mathematics in Context

PAPER 2: Applications

You must have: Ruler graduated in centimetres and millimetres, pen, HB pencil, eraser, calculator.
Source booklet (enclosed)

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- **Calculators may be used.**

Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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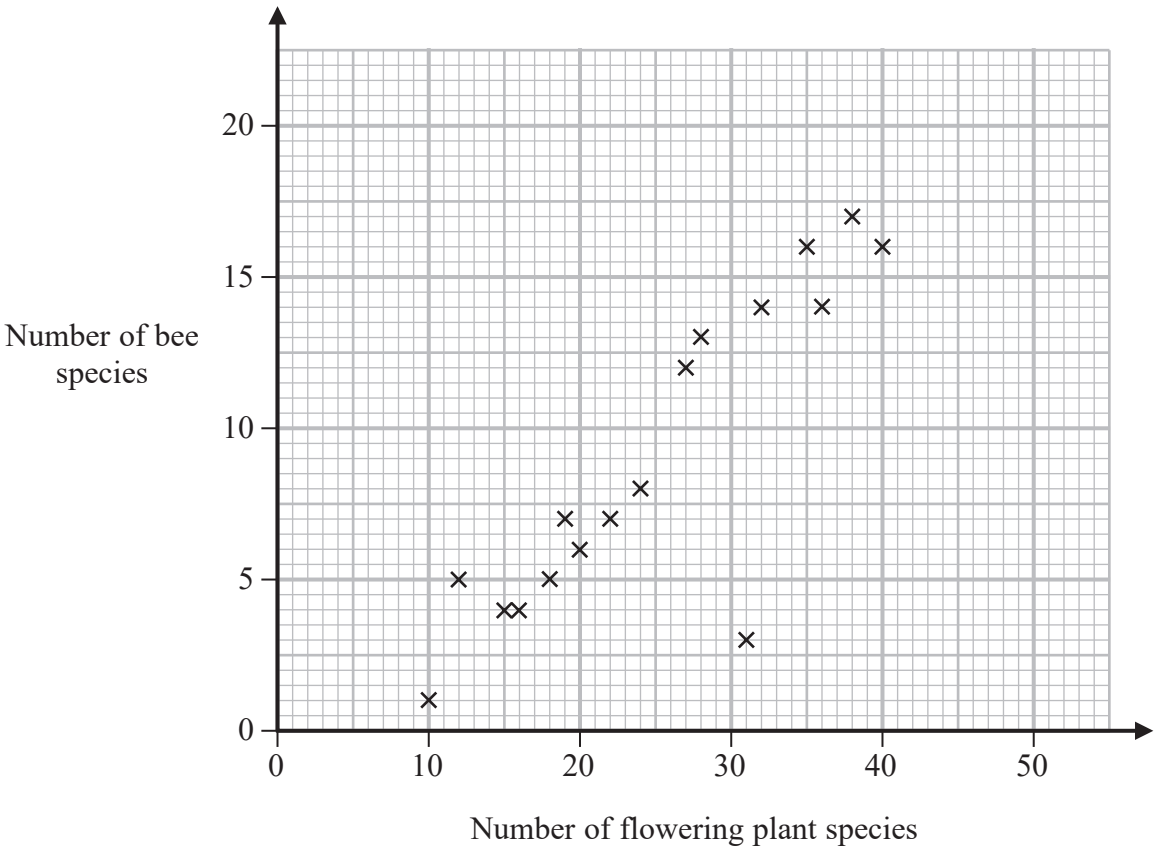
SECTION A

Answer ALL questions. Write your answers in the spaces provided.

BEES

1 Refer to **data source A** in the source booklet for Question 1.

Some of the data in **Table 1** is represented on the scatter graph below.



The first seventeen data points have been plotted.

(a) Plot the final **three** data points.

(1)

(b) Describe the relationship shown by the scatter graph.

(1)

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It is suspected that the number of bee species has been counted incorrectly at one of the locations surveyed.

(c) (i) Write down the number of flowering plant species at this location.

(1)

.....

At a new location, 10 bee species were counted.

(ii) Ignoring the location identified in part (c)(i), estimate the number of flowering plant species expected to be counted.
You must show how you get your answer.

(2)

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.....

(iii) Comment on the reliability of your answer to (c)(ii).

(1)

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Gea suggests the number of flowering plant species is the dependent (response) variable.
Mateo suggests the number of bee species is the dependent (response) variable.

(d) Explain how both Gea and Mateo could be correct.

(1)

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(Total for Question 1 is 7 marks)

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2 Refer to **data source B** in the source booklet for Question 2.

The distance from the hive of a source of pollen can be modelled by the formula

$$d = At + B$$

where

t is the duration of the dance in seconds, for $t \geqslant 1$
d is the distance from the hive to the source of pollen in metres
A and B are constants.

(i) Find the value of A and the value of B.

(4)

A bee finds a source of pollen that is 4000 m from the hive.

(ii) Use the model to find the duration, in seconds, of the corresponding dance.

(2)

(Total for Question 2 is 6 marks)

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3 Due to the use of agricultural chemicals, it is predicted that a colony of bees will decrease in population by 20% each year.

If the colony size falls below 10 000 then it will become unviable.

In 2023 there were 80 000 bees in a particular colony.

Show that, according to the prediction, the colony will be unviable by the year 2033.

(Total for Question 3 is 2 marks)

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4 Kai owns a beehive.
He wants to sell the honey that is produced.

The average yield of honey per hive depends upon the type of summer.

The table shows the probability and the average yield of honey per hive, in kilograms, for each type of summer.

Type of summer	Probability	Average yield of honey (kilograms)
Good summer	0.5	27
Average summer	0.36	20
Poor summer	0.14	9

Kai has two options

- sell the honey to a farm shop for £12 per kilogram **and** get a one-off payment of £70
- sell the honey himself for £15 per kilogram.

Which of the options will give the greatest expected income?
You must show all your working.

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(Total for Question 4 is 5 marks)

TOTAL FOR SECTION A IS 20 MARKS

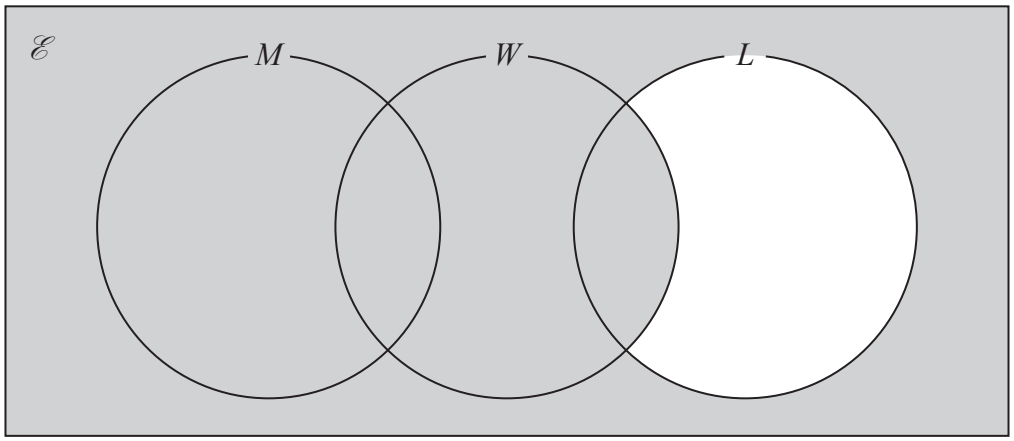
SECTION B

Answer ALL questions. Write your answers in the spaces provided.

TASK 1: FISH

5 A lake is stocked with trout.

The Venn diagram shows some information about these trout.



$\mathscr{E}$ = {trout in the lake}
M = {male trout}
W = {trout that have a weight less than 1 kg}
L = {trout that have a length less than 40 cm}

The sets M and L do not intersect.

(a) (i) Explain what this represents in terms of the trout in the lake.

(1)

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(ii) Describe, in context, $M \cap W'$

(1)

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(iii) Write, using set notation, the set in the Venn diagram represented by the shaded region.

(1)

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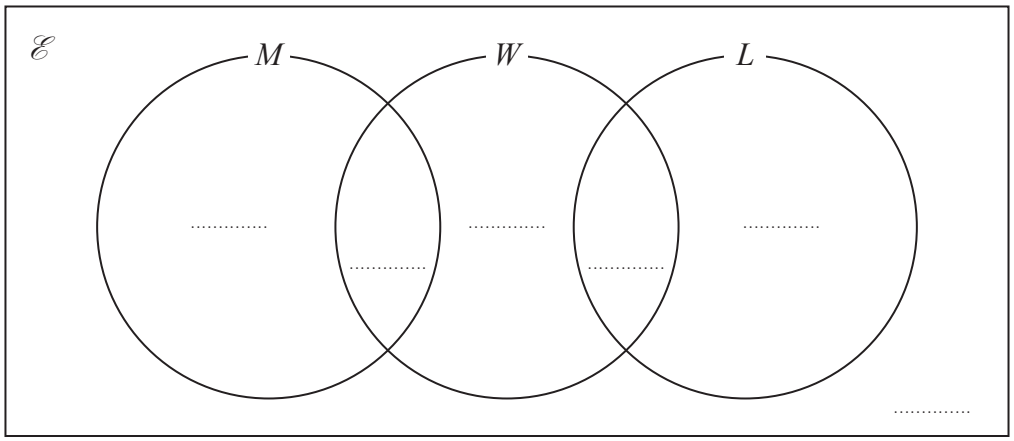
There are 500 male trout and 500 female trout in the lake.

103 of the male trout have a weight less than 1 kg.
209 of the female trout have a weight less than 1 kg.
200 of the female trout have a length less than 40 cm.
137 of the female trout have a weight less than 1 kg **and** have a length less than 40 cm.



(b) Complete the Venn diagram for the information given above.

(4)

(c) (i) Find P(W)

(1)

(ii) Find P($L|M'$)

(2)

(iii) Write down P($M'|L$)

(1)

(Total for Question 5 is 11 marks)

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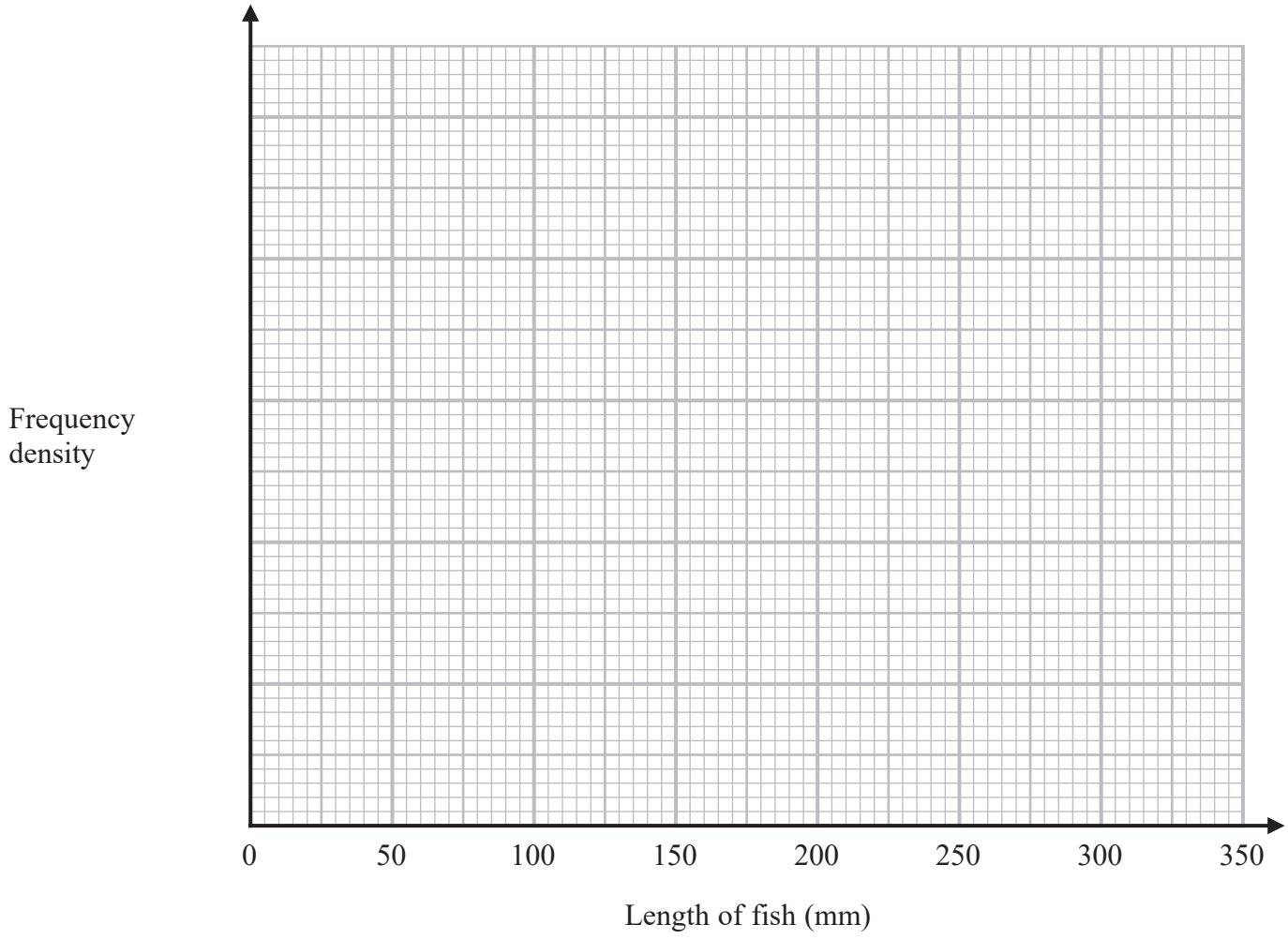
6 A different lake contains 600 Calico bass.

The distribution of the lengths, in millimetres, of these fish is shown in the table below.

Length of fish (L mm)	Frequency
$60 \leqslant L < 100$	32
$100 \leqslant L < 150$	85
$150 \leqslant L < 230$	168
$230 \leqslant L < 300$	245
$300 \leqslant L < 350$	70

(a) On the grid, draw a histogram to represent this data.

(4)



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A Calico bass from this lake is caught at random.

(b) Estimate the probability that the length of this fish is greater than 200 mm.

(2)

(c) Estimate the ratio of the number of Calico bass in the lake with a length between 180 mm and 260 mm to the total number of Calico bass in the lake.

(3)

(Total for Question 6 is 9 marks)

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TASK 2: BAGS

7 The table below shows the number of single-use plastic bags given away each year by supermarkets in England for the years 2011 to 2014.

Year	Number of single-use plastic bags (millions)
2011	6800
2012	7100
2013	7400
2014	7700

Blanca suggests that the number of single-use plastic bags given away each year can be modelled using

$$B_n = 6800 + (n - 1)d$$

where

n is the number of years after 2010
B_n is the number of single-use plastic bags given away, in millions, in year n
d is a constant.

(a) (i) Write down the value of d.

(1)

.....

(ii) State **one** assumption Blanca has made.

(1)

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(b) (i) Calculate the number of single-use plastic bags that will be given away in 2019 according to this model.

(2)

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(ii) Calculate the **total** number of single-use plastic bags that will be given away from the beginning of 2011 to the end of 2019 according to this model.

(2)

In October 2015 the government introduced a charge of 5p for each single-use plastic bag in England to try to reduce the number of bags being used.

The actual number of single-use plastic bags used in 2019 was 8% of the 7700 million used in 2014.

(c) Calculate the income from the actual number of single-use plastic bags used in 2019. Give your answer in pounds.

(2)

Using the model, Blanca expected supermarkets in England to sell 9800 million single-use plastic bags in 2021.

The actual number of single-use plastic bags sold was 440 million in 2021.

Each single-use plastic bag weighs 6 grams.

Given that $\frac{7}{9}$ of all single-use plastic bags sold in 2021 are sent to landfill,

(d) work out the reduction, from expected sales to actual sales, in the weight of single-use plastic bags sent to landfill.
Give your answer in kilograms.

(4)

(Total for Question 7 is 12 marks)

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8 In 2018, a shop sold 2635 single-use plastic bags and 5318 reusable plastic bags.

Each single-use plastic bag weighs 6 grams.
Each reusable plastic bag weighs 28 grams.

In 2022, the shop

- sold 1857 single-use plastic bags
- n reusable plastic bags
- reduced the total weight of the plastic bags sold to less than half the total weight of the plastic bags sold in 2018.

(i) Show that this information can be represented by

$$11\,142 + 28n < 82\,357$$

(3)

(ii) Find the maximum number of reusable plastic bags the shop could have sold in 2022.

(2)

(Total for Question 8 is 5 marks)

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9 In 2020, the mean number of single-use plastic bags used per person in EU countries was 87.2

The mean number of single-use plastic bags used per person in EU countries is 10 times greater than the mean number of single-use plastic bags used per person in England.

The population of England in 2020 was 56.55 million.

Calculate the total number of single-use plastic bags used in England in 2020.

(Total for Question 9 is 3 marks)

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TASK 3: DAIRY PRODUCTS

10 A farmer makes and sells cream and yoghurts to shops.

The owner of shop A buys 20 pots of cream and 8 trays of yoghurts.
The total cost is £81.12

The owner of shop B buys 14 pots of cream and 9 trays of yoghurts.
The total cost is £76.47

The owner of shop C buys 32 pots of cream and 13 trays of yoghurts.

Work out the total cost of 32 pots of cream and 13 trays of yoghurts.

(Total for Question 10 is 6 marks)

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11 The farmer also makes hard cheese and soft cheese.

It takes 8 gallons of milk and 1.5 ml of enzyme to make a wheel of hard cheese.
It takes 2 gallons of milk and 1.25 ml of enzyme to make a wheel of soft cheese.

There are 232 gallons of milk available each month to make cheese.
There are 75 ml of enzyme available each month to make cheese.

Let x be the number of wheels of hard cheese the farmer will make each month.
Let y be the number of wheels of soft cheese the farmer will make each month.

(a) (i) Show that $4x + y \leqslant 116$ and $6x + 5y \leqslant 300$

(3)

A third constraint is $x \leqslant 7y$

(ii) Explain, in context, what this inequality represents.

(1)

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The farmer can make a maximum number of each type of cheese per month.
Two further constraints to represent this are shown on the grid.

(b) Write an inequality for each of the two constraints shown.

(2)

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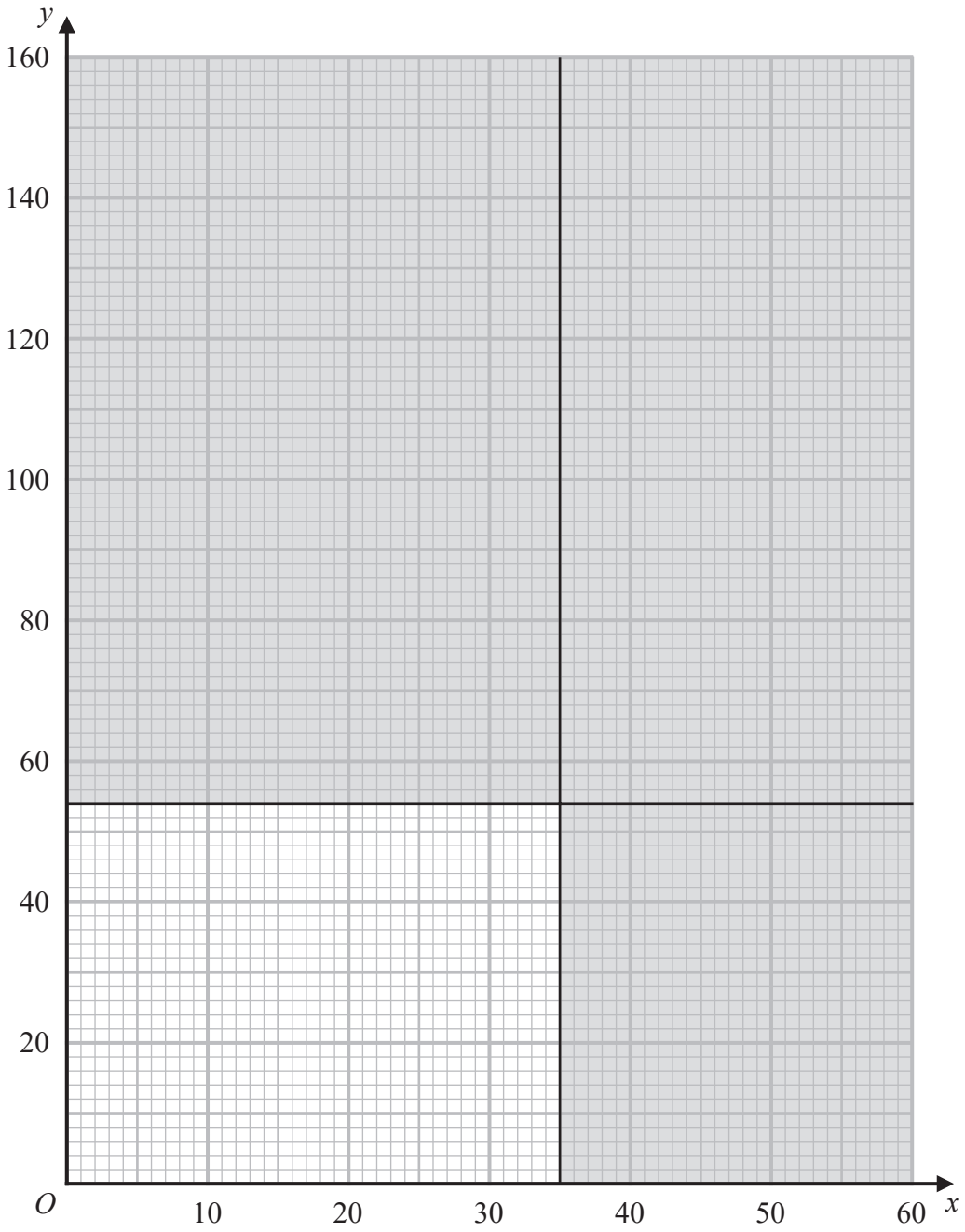

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(c) On the grid opposite, represent the inequalities

$$4x + y \leqslant 116 \qquad 6x + 5y \leqslant 300 \qquad x \leqslant 7y$$

Label the feasible region R.

(4)

The farmer will sell each wheel of hard cheese for £25 and each wheel of soft cheese for £18

Assuming the farmer sells all the wheels of cheese he makes,

(d) find the maximum total sales amount each month.
You should state the number of each type of cheese wheel the farmer will sell.

(4)

(Total for Question 11 is 14 marks)

TOTAL FOR SECTION B IS 60 MARKS
TOTAL FOR PAPER IS 80 MARKS

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Pearson Edexcel Level 3 Certificate

Tuesday 11 June 2024

Afternoon (Time: 1 hour 40 minutes)

Paper reference **7MC0/02**

Mathematics in Context

PAPER 2: Applications

Source Booklet

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Formulae sheet

There will be no credit for anything you write on this formulae sheet.

Mean of a frequency distribution $= \dfrac{\sum fx}{\sum f}$

Mean of a grouped frequency distribution $= \dfrac{\sum fx}{\sum f}$, where x is the mid-interval value

Variance $= \dfrac{\sum (x - \bar{x})^2}{n}$

Standard deviation (set of numbers) $\sqrt{\left[\dfrac{\sum x^2}{n} - \left(\dfrac{\sum x}{n}\right)^2\right]}$

or $\sqrt{\left[\dfrac{\sum (x - \bar{x})^2}{n}\right]}$

where $\bar{x}$ is the mean of the set of values

Standard deviation

(discrete frequency distribution) $\sqrt{\left[\dfrac{\sum fx^2}{\sum f} - \left(\dfrac{\sum fx}{\sum f}\right)^2\right]}$

or $\sqrt{\left[\dfrac{\sum f(x - \bar{x})^2}{\sum f}\right]}$

Spearman's rank correlation coefficient $1 - \dfrac{6\sum d^2}{n(n^2 - 1)}$

The product moment correlation coefficient is

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{\sum x_i y_i - \frac{\left(\sum x_i\right)\left(\sum y_i\right)}{n}}{\sqrt{\left(\sum x_i^2 - \frac{\left(\sum x_i\right)^2}{n}\right)\left(\sum y_i^2 - \frac{\left(\sum y_i\right)^2}{n}\right)}}$$

The regression coefficient of y on x is $b = \frac{S_{xy}}{S_{xx}}$

Least squares regression line of y on x is $y = a + bx$ where $a = \bar{y} - b\bar{x}$

Arithmetic series

$$u_n = a + (n - 1)d$$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n[2a + (n - 1)d]$$

Geometric series

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r}$$

$$S_\infty = \frac{a}{1 - r} \text{ for } |r| < 1$$

There will be no credit for anything you write in this source booklet.

SECTION A: BEES

Data source A

A survey was conducted to investigate the relationship between the number of bee species and the number of flowering plant species in a number of locations.

Table 1: The number of bee species and the number of flowering plant species counted at twenty locations

Number of flowering plant species	Number of bee species
10	1
40	16
12	5
28	13
15	4
38	17
16	4
18	5
35	16
19	7
20	6
24	8
27	12
31	3
32	14
22	7
36	14
11	2
26	9
39	15

Data source B

When bees find a source of pollen they return to the hive and perform a dance to indicate the direction and distance of the source from the hive.

Table 2: The duration of the dance, in seconds, and the corresponding distance from the hive, in metres, of the source of pollen

Duration of dance (seconds)	Distance to source of pollen (metres)
1	825
2	2075
3	3325
4	4575
5	5825

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Source information

Data source A adapted from:
https://www.researchgate.net/publication/266976680_Community_structure_and_diversity_of_vegetation_and_flower-visiting_wild_bees_Hymenoptera_Apoidea_in_sandy_dry_grassland_Are_there_congruent_characteristics

Data source B adapted from:
https://content.ces.ncsu.edu/honey-bee-dance-language